WHAT IS CLAIMED IS:

1. An electron source device comprising:

an oxide substrate having a number of small through holes;

electron-emitting material buried in the through holes;

a first electrode formed on one surface of the oxide substrate and contacting the electron-emitting material; and

a second electrode provided on another surface side of the oxide substrate, insulated from the electron-emitting material and configured to concentrate an electron field of the electron-emitting material by virtue of an voltage applied between the first electrode and the second electrode, so as to cause the electron-emitting material to emit electrons.

2. The electron source device according to claim 1, wherein the oxide substrate is made of alumina.

3. The electron source device according to claim 1, wherein the electron-emitting material is a carbon-based material.

4. The electron source device according to claim 1, wherein the through holes have a diameter of 500 μm to 0.1 nm, and the oxide substrate has a thickness of 0.1 μm to 10 mm.

5. The electron source device according to

claim 4, wherein the through holes have a diameter of 10 μm to 1 nm.

6. The electron source device according to claim 1, wherein the second electrode is provided on another surface of the oxide substrate.

7. The electron source device according to claim 1, further comprising a third electrode provided on an opposite side, sandwiching the second electrode jointly with the first electrode.

8. The electron source device according to claim 1, wherein the through holes have a two-stepped configuration comprising a part located near the first electrode and a part located near the second electrode and having a diameter larger than the part near the electrode.

9. A method of manufacturing an electron source device, comprising:

subjecting a metal substrate to electrolytic oxidation, thereby forming an oxide substrate having a number of small through holes;

burying an electron-emitting material in the through holes of the oxide substrate;

forming a first electrode on one surface of the oxide substrate, said first electrode contacting the electron-emitting material; and

forming a second electrode on another surface of the oxide substrate, said second electrode insulated

from the electron-emitting material.

10. The method of manufacturing an electron source device, according to claim 9, wherein an electrolysis voltage is controlled, in the electrolytic oxidation, to control the diameter of the small through holes.

11. The method of manufacturing an electron source device, according to claim 9, wherein an electrolysis time is controlled, in the electrolytic oxidation, to control the diameter of the small through holes.

12. The method of manufacturing an electron source device, according to claim 9, wherein the electron-emitting material is buried in the through holes by introducing an organic substance into the through holes and then baking the organic substance to carbonize the substance.

13. The method of manufacturing an electron source device, according to claim 12, wherein the oxide substrate is coated with an mold release agent before the organic substance is introduced.

14. The method of manufacturing an electron source device, according to claim 9, wherein the electron-emitting material is buried in the through holes by vapor-depositing an organic substance in the through holes.

15. A flat display apparatus comprising:

a first substrate and a second substrate arranged, opposing to each other;

phosphor layers provided on an inner surface of the first substrate; and

an electron source device provided on an inner surface of the second substrate, configured to excite the phosphor layers, and comprising an oxide substrate having a number of small through holes and provided on an inner surface of the second substrate, electron-emitting material buried in the through holes, a first electrode formed on that surface of the oxide substrate, which faces the second substrate, and contacting the electron-emitting material, and a second electrode provided on other surface side of the oxide substrate, insulated from the electron-emitting material and configured to concentrate an electron field of the electron-emitting material by virtue of an voltage applied between the first electrode and the second electrode so as to cause the electron-emitting material to emit electrons toward the phosphor layers.

16. The flat display apparatus according to claim 15, wherein the through holes have a diameter of 500 μm to 0.1 nm, and the oxide substrate has a thickness of 0.1 μm to 10 mm.

17. The flat display apparatus according to claim 15, wherein the second electrode is provided on the other surface of the oxide substrate.

18. The flat display apparatus according to claim 15, which comprises a third electrode sandwiching

the second electrode, jointly with the first electrode, and configured to converge the electrons emitted.